4.2.1 WATER-SUPPLY WELLS

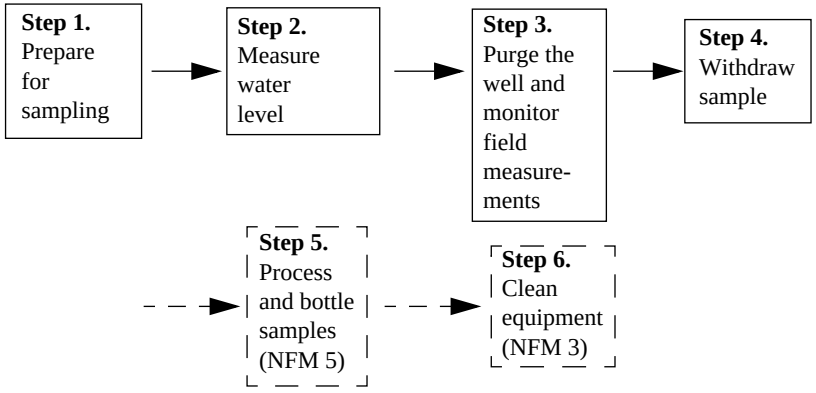
Collection of samples from water-supply wells with permanently installed pumps requires specific considerations, preparations, and precautions. Refer to other NFM chapters for guidelines for reconnaissance and preparations at supply-well sites (NFM 1) and safety precautions (NFM 9). Field personnel should be aware of the potential sources of contamination to samples withdrawn from supply wells (table 4-5; NFM 1).

- Do not sample the well if it is not possible to bypass any holding tank or chemical treatment system.
- Document all field observations and any deviations from standard sampling procedures.
- Obtain permission for access to and collection of samples and data from the well.

Table 4-5. Advantages and disadvantages of collecting water samples from supply wells with permanently installed pumps

Advantages
• Cost of well and pump installation is not a factor. • Samples from domestic and municipal wells (for studies of the quality of potable water supplies) are collected directly from the resource being studied. • Pumps are dedicated to the site; therefore, - cross-contamination of other wells from pumping equipment is not a problem, and - field time and effort otherwise expended in operating and cleaning portable pumps can be allocated to other tasks. • In-service supply wells generally require a minimal amount of purging at the time of sampling.
Disadvantages
• The well and the open or screened intervals might not isolate the aquifer zone where water-quality information is needed. • Materials of construction of well and pump may affect concentrations of the analytes targeted for study. • Pumps with high capacities can alter the water chemistry of a sample if the pump is lubricated with oil. The water chemistry of a sample can also be altered by aeration and degassing caused by high-velocity pumping, suction lift, and cavitation. • Access for water-level measurements might be unavailable; or, access might be indirect (through an air line), thus yielding less accurate measurements.

Protocols and guidelines for sampling from water-supply wells



Be sure that the field effort is adequately staffed and equipped. Check QC requirements before departing—QC samples require additional equipment and supplies. Implement good field practices and *CH/DH* techniques, as applicable (duties typically performed by Clean Hands (*CH*) and Dirty Hands (*DH*) are indicated in the steps that follow).

Step 1. Prepare for sampling at a supply-well site *(CH/DH)*.

a. Upon arrival, set out safety equipment such as traffic cones and signs. Park vehicle in a position to prevent sample contamination from vehicle and traffic emissions and the prevailing wind.

   - Check the well identification number and compare it with the number in the well file and in field notes (NFM 1).
   - Assign *CH/DH* tasks.

b. Describe well and site conditions in field notes and (or) on field forms, as appropriate (*DH*).

c. Check site for hazardous conditions (NFM 9) (*DH*).

   - Test for toxic fumes if the well is in an enclosed structure or if there is reason to suspect the presence of organic vapors.
   - Examine the area for evidence of animal infestation and other potential safety hazards.

d. Calibrate field-measurement instruments (*DH*). (Refer to NFM 6 for instructions.)

e. Spread clean plastic sheeting (for example, a polypropylene tarp) around the well to keep sampling equipment and sample tubing clean. Prepare area to be used for field cleaning of equipment (*DH*). Put on gloves.

f. Set up sample processing and preservation chambers in a clean workspace (usually in the water-quality field vehicle). Change gloves. Place filter unit and other necessary supplies for sample collection and processing into the processing chamber (*CH*).

g. Connect sample tubing as close to the wellhead as possible (*DH*).

   i. Determine the location and method of hookup to the well.

      - There must be no water-storage tanks, holding or pressurization tanks, or chemical disinfection or water-softening systems inline between the pump and tap or faucet to which sample tubing will be attached. Obtain written permission to install a tap to bypass any holding tank or chemical treatment system.
      - Select a faucet without an aerator, or obtain written permission from the owner to remove the aerator.

   ii. Use connectors and sample tubing that are compatible with the target analytes and that will not contaminate the sample. Clean connectors and tubing before use. At highly contaminated sites, it is recommended that this equipment be dedicated to that site or disposable equipment be used. Because connector fittings compatible with existing plumbing can vary, check that you have the size and configuration needed, and carry various sizes as spares.

   iii. Connect a short length of sample tubing (2 to 3 ft) between the tap/faucet fitting and the antibacksiphon valve (*DH*).

   iv. Connect an adequate length of sample tubing from the antibacksiphon valve to manifold; from manifold, connect lines to flowthrough chamber, to processing chamber, and to waste discharge. Keep the discharge end of the sample tubing sealed until use. Keep tubing for sample and field-measurement lines as short as possible and protected from direct sunlight and extreme temperatures.

      - Tubing that transfers sample to the processing chamber must be of noncontaminating material, such as fluorocarbon polymer, and handled by *CH*.

- Tubing connected to a flowthrough chamber for field measurements that is used for that purpose only (not for sample collection) can be of any material, but should be transparent in order to see if bubbles or sediment are entrained in the sample flow (*DH*).
- Tubing that is used solely to discharge purged water or other wastewater can be of any material, but needs to be long enough to direct water away from the work area (*DH*).

Step 2. Measure water level *(DH)*.

Procedures and equipment for water-level measurement depend on well type and construction and the presence of nonaqueous liquid phases.

a. Put on gloves if chalking a steel tape. Using a weighted steel or electric tape in a nonpumping well, measure water level to the nearest 0.01 ft (for wells < 200 ft to water); repeat measurement until precision is within 0.02 ft. At deep wells, calculate the compensation factor to account for tape stretching.
   - Care must be taken not to entangle the well tape in the pump discharge pipe or intake.
   - An unweighted tape might be necessary if the weight cannot fit past the pump apparatus.
   - At some supply wells, the water level can only be estimated using the less accurate air-line method.

b. Record water-level measurements on field forms (fig. 4-7) and note any deviations from standard water-level measuring procedures.

Step 3. Purge the well and monitor field measurements *(DH)*.

A supply well that is in regular service and that is pumping continuously or that has been operating long enough to have removed three casing volumes of water within several hours of sample collection does not require removal of three well volumes. Sample tubing needs to be flushed with sample and the field measurements monitored before sampling, however. It is recommended that water level in the well should be maintained above the screened or open interval to ensure a representative sample.

- Adjust the flow rate at the pump (preferable) or use a manifold with a flow-regulating valve (needle valve), if possible. The flow-regulating valve is necessary to prevent backpressure and air bubbles from building in the line. **Flow should not be halted or the flow rate changed suddenly during the final phases of purging and sampling.**
- The pump should produce a smooth, solid stream of water without air or gas bubbles and without pump cavitation during field measurements and sample withdrawal.
- **Contain and dispose of purge water as required by Federal, State, or local regulations.** Do not discharge the purge water from one well into another without proper authorization. Discharge the water far enough away from a well or well cluster so as not to affect water quality in the well.

a. Calculate the well volume: Volume, in gallons = (0.0408) x (Height of water column) x (inside Diameter^2 of well, in inches). Note that depth to bottom of well and inside casing diameter must be known to calculate well volume. Begin to calculate the three well volumes after discharging the initial volume of water to waste until sediment is cleared from the flow. Record the start and end times of purging, the purging rate, water levels, and location of pump intake (fig. 4-7).

   - Field personnel could request a site operator or homeowner to start pumping the well before personnel arrive at the site.
   - If the pump is turned off but three well volumes have been removed within 24 hours before sampling, additional purging is not necessary if samples will be analyzed only for concentrations of nutrients or major ions. Purging immediately before sampling is recommended if samples for trace elements and volatile organic compounds will be collected.

b. Open any additional valves or taps/faucets to ensure that the pump will operate continuously and to reduce the possibility of backflow of water stored in ancillary plumbing lines. Keep all principal discharge lines (faucets and tap) open during sample collection that are open during purging. Flow must not be interrupted during purging, field measurements, or sample collection.

c. Begin flow through the flowthrough chamber for field measurements. Adjust flow to the chamber (NFM 6) from the pump, if possible, using a manifold with flow-regulating valves. Do not use a flow-splitting valve to adjust flow rate.

Once flow is constant, begin monitoring field measurements. (Instructions for monitoring field measurements are provided in NFM 6.)

- To control the flow rate from the manifold, a flow-regulating valve (such as a needle valve) is needed.
- Keep three-way valves either completely open or closed. Partially open three-way valves can create a vacuum and air bubbles and can draw in water that has possibly been in contact with contaminating materials. Do not use a three-way valve or flow-splitting valve to regulate the flow.

d. Calculate and record the final pumping rate. When water is flowing through more than one conduit (valve, tap/faucet, manifold lines) calculate the pumping rate by summing the rate of flow through each conduit. The final pumping rate, used during the final five sets of field measurements, also should be used during sample collection.

e. As the final well volume is removed, record on field forms at least five sets of field measurements at regularly spaced intervals and check data against stability criteria (fig. 4-7; NFM 6). Recommended measurements include specific electrical conductance, pH, temperature, dissolved oxygen, and turbidity.

Step 4. Withdraw sample (*CH*).

Flow should be constant and uninterrupted during purging and sampling. Regulate flow at the pump (as described below in Step 3).

a. Wearing gloves, check that the sample tubing is properly secured within the processing chamber.

b. Direct sample flow through sample tubing to processing chamber immediately after final field measurements have been recorded.

Step 5. Process sample ➜ Refer to NFM 5.

RULE OF THUMB: The rate of flow for filling sample bottles should not exceed

- 500 mL/min for bottles 250 mL or greater in volume, or
- 150 mL/min for 40-mL VOC vials.

Step 6. Clean equipment ➜ Refer to NFM 3.

At highly contaminated sites, use sample tubing that is disposable or dedicated to that site in order to minimize the risk of cross-contamination between wells. Wear gloves while cleaning and handling sampling equipment.

- Rinse sampling equipment with deionized water before the equipment dries.
- Clean equipment to be used at another well during the same field trip after rinsing and before moving to the next site.
- Collect field blanks used to assess equipment-cleaning procedures directly after the sampling equipment has been cleaned in the field or after moving to the next site and before sampling, as dictated by the data-quality requirements of the study (section 4.3).